


National Aeronautics and Space Administration



Fiscal Year 2011 BUDGET ESTIMATES



Today we are launching a bold and ambitious new space initiative to enable us to explore new worlds, develop more innovative technologies, foster new industries, increase our understanding of the earth, expand our presence in the solar system, and inspire the next-generation of explorers...

NASA Administrator Charles Bolden
February 1, 2010

Highlights of NASA's FY 2011 Budget

- Top line increase of \$6.0 billion over 5-years (FY 2011-15) compared to the FY 2010 Budget, for a total of \$100 billion over five years.
- Significant and sustained investments in:
 - Transformative technology development and flagship technology demonstrations to pursue new approaches to space exploration;
 - Robotic precursor missions to multiple destinations in the solar system;
 - Research and development on heavy-lift and propulsion technologies;
 - U.S. commercial spaceflight capabilities;
 - Future launch capabilities, including work on modernizing Kennedy Space Center after the retirement of the Shuttle;
 - Extension and increased utilization of the International Space Station;
 - Cross-cutting technology development aimed at improving NASA, other government, and commercial space capabilities;
 - Accelerating the next wave of Climate change research and observations spacecraft;
 - NextGen and green aviation; and
 - Education, including focus on STEM.
- Cancellation of the Constellation program; and \$600 million in FY 2011 to ensure the safe retirement of the Space Shuttle upon completion of the current manifest.

Funding Table

| Budget Authority (\$M) | FY 2009 | ARRA | FY 2010 | FY 2011 | FY 2012 | FY 2013 | FY 2014 | FY 2015 |
|---|----------|---------|----------|----------|----------|----------|----------|----------|
| Science | 4,503.1 | 400.0 | 4,493.3 | 5,005.6 | 5,248.6 | 5,509.6 | 5,709.8 | 5,814.0 |
| Earth Science | 1,377.3 | 325.0 | 1,420.7 | 1,801.7 | 1,944.4 | 2,089.4 | 2,216.5 | 2,282.1 |
| Planetary Science | 1,288.1 | | 1,341.3 | 1,485.8 | 1,547.3 | 1,591.3 | 1,630.2 | 1,649.5 |
| Astrophysics | 1,229.9 | 75.0 | 1,103.9 | 1,076.3 | 1,109.3 | 1,149.1 | 1,158.7 | 1,131.6 |
| Heliophysics | 607.8 | | 627.4 | 641.9 | 647.6 | 679.8 | 704.4 | 750.8 |
| Aeronautics and Space Research and Technology | 500.0 | 150.0 | 507.0 | 1,151.8 | 1,596.9 | 1,650.1 | 1,659.0 | 1,818.2 |
| Aeronautics Research | 500.0 | 150.0 | 507.0 | 579.6 | 584.7 | 590.4 | 595.1 | 600.3 |
| Space Technology | | | | 572.2 | 1,012.2 | 1,059.7 | 1,063.9 | 1,217.9 |
| Exploration | 3,505.5 | 400.0 | 3,779.8 | 4,263.4 | 4,577.4 | 4,718.9 | 4,923.3 | 5,179.3 |
| Space Operations | 5,764.7 | | 6,180.6 | 4,887.8 | 4,290.2 | 4,253.3 | 4,362.6 | 4,130.5 |
| Space Shuttle | 2,979.5 | | 3,139.4 | 989.1 | 86.1 | | | |
| International Space Station | 2,060.2 | | 2,317.0 | 2,779.8 | 2,983.6 | 3,129.4 | 3,221.9 | 3,182.8 |
| Space and Flight Support (SFS) | 725.0 | | 724.2 | 1,119.0 | 1,220.6 | 1,123.9 | 1,140.7 | 947.7 |
| Education | 169.2 | | 183.8 | 145.8 | 145.8 | 145.7 | 145.7 | 146.8 |
| Cross-Agency Support | 3,306.4 | 50.0 | 3,095.1 | 3,111.4 | 3,189.6 | 3,276.8 | 3,366.5 | 3,462.2 |
| Center Management and Operations | 2,024.3 | | 2,067.0 | 2,273.8 | 2,347.4 | 2,427.7 | 2,509.7 | 2,594.3 |
| Agency Management and Operations | 921.2 | | 941.7 | 837.6 | 842.2 | 849.1 | 856.8 | 867.9 |
| Institutional Investments | 293.7 | 50.0 | 23.4 | | | | | |
| Congressionally Directed Items | 67.2 | | 63.0 | | | | | |
| Construction and Environ. Compliance and Restor. | | | 448.3 | 397.3 | 363.8 | 366.9 | 393.5 | 398.5 |
| Inspector General | 33.6 | 2.0 | 36.4 | 37.0 | 37.8 | 38.7 | 39.6 | 40.5 |
| NASA FY 2010 | 17,782.4 | 1,002.0 | 18,724.3 | 19,000.0 | 19,450.0 | 19,960.0 | 20,600.0 | 20,990.0 |
| <i>Year to Year Change</i> | | | 5.3% | 1.5% | 2.4% | 2.6% | 3.2% | 1.9% |

Exploration Research & Development

- ▶ The Budget includes three new robust exploration programs:
 1. Technology demonstration program, \$7.8 billion over five years.
Funds the development and demonstration of technologies that reduce the cost and expand the capabilities of future exploration activities, including in-orbit refueling and storage.
 2. Heavy-Lift and Propulsion R&D, \$3.1 billion over five years.
Funds R&D for new launch systems, propellants, materials, and combustion processes.
 3. Robotic precursor missions, \$3.0 billion over five years.
Funds cost-effective means to scout exploration targets and identify hazards and resources for human visitation and habitation.
- ▶ In addition, the Budget enhances the current Human Research Program by 42%; and supports the Participatory Exploration Program at \$5 million per year (for activities across many NASA

1. Critical Technology Demonstrations

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---------------------------|-------|---------|---------|---------|---------|
| Exploration Tech and Demo | \$652 | \$1,262 | \$1,808 | \$2,013 | \$2,087 |

- ▶ Led by NASA's Exploration Directorate, components include:
 - ▶ *Flagship demonstration program:*
 - ▶ Pursues projects that are generally funded at \$0.4-\$1.0 billion over lifetimes of less than 5-years, and that can include partnerships with international, commercial and other government entities.
 - ▶ Demonstrates critical technologies such as in-orbit propellant transfer and storage, inflatable modules, automated/autonomous rendezvous and docking, closed-loop life support systems, and other next-generation capabilities.
 - ▶ *Enabling technology development program:*
 - ▶ Pursues smaller scale (less than \$100 million generally) and shorter duration projects that are competitively selected and also can involve commercial, academic, and international partners.
 - ▶ Demonstrates a broad range of key technologies, including in-situ resource utilization and advanced in-space propulsion.

2. Heavy-Lift and Propulsion R&D

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------------------------|-------|-------|-------|-------|-------|
| Heavy-lift and propulsion R&D | \$559 | \$594 | \$597 | \$598 | \$754 |

- ▶ Led by NASA's Exploration Directorate, this program will investigate a broad scope of R&D activities to support next-generation space launch propulsion technologies.
- ▶ This program seeks to both reduce costs and shorten development timeframes for future heavy-lift systems.
- ▶ Target R&D activities include:
 - ▶ New approaches to first-stage launch propulsion;
 - ▶ In-space advanced engine technology development and demonstrations; and
 - ▶ Foundational – basic - propulsion research.
- ▶ Projects may include intra-governmental, commercial, academic and international partnerships.



3. Robotic Precursor Missions

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------|-------|-------|-------|-------|-------|
| Robotic Precursors | \$125 | \$506 | \$699 | \$797 | \$923 |

- ▶ Led by NASA's Exploration Directorate, this program will send robotic precursor missions to the Moon, Mars and its moons, Lagrange points, and nearby asteroids to scout targets for future human activities, and identify the hazards and resources that will determine the future course of the expansion of human civilization into space. Projects will generally support missions that are less than \$800 million in life-cycle cost.
- ▶ Research goals include testing technologies and operational concepts and making observations that can benefit future human activities in space.
- ▶ Missions may include:
 - ▶ Landing on the Moon with a robot that can be tele-operated from Earth and can transmit near-live video.
 - ▶ Demonstrating a factory to process lunar or asteroid materials for use for various purposes.

Full Utilization of the ISS

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|-----------------|---------|---------|---------|---------|---------|
| ISS Utilization | \$2,780 | \$2,984 | \$3,129 | \$3,222 | \$3,183 |

- ▶ Increases by \$463 million over FY 2010 enacted, and \$2 billion over 4-years (FY 2011-14) compared to the FY 2010 Budget.
- ▶ Supports extension of the lifetime of the ISS likely to 2020 or beyond in concert with our international partners.
- ▶ Funds programs to:
 - ▶ Increase Station capabilities through upgrades to both ground support and onboard systems; and
 - ▶ Support ISS's national laboratory activities.
- ▶ *The goal will be to fully utilize the Station's R&D capabilities to conduct scientific research, improve our capabilities for operating in space, and demonstrate new technologies developed through NASA's other programs.*



Commercial Crew and Cargo

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|------------------|-------|---------|---------|---------|---------|
| Commercial Crew | \$500 | \$1,400 | \$1,400 | \$1,300 | \$1,200 |
| Commercial Cargo | \$312 | -- | -- | -- | -- |

- Building off successful progress in the development of commercial cargo capabilities, the Budget invests \$6 billion over five years to spur the development of American commercial human spaceflight vehicles.
- NASA will allocate these funds through competitive solicitations that support a range of higher- and lower-programmatic risk systems and system components, such as human-rating of existing launch vehicles and development of new spacecraft that can ride on multiple launch vehicles. NASA will ensure that all systems meet the agency's stringent human-rating requirements.
- In addition, to these commercial spaceflight amounts, the Budget provides (only in FY 2011) \$312 million for additional incentives for NASA's current domestic commercial cargo service providers.

Space Shuttle

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---------|-------|------|------|------|------|
| Shuttle | \$989 | \$86 | -- | -- | -- |

- ▶ Adds \$600 million to the FY 2011 budget to fund the Shuttle to fly out its remaining five flights, even if those flights slip into the first quarter of FY 2011.
- ▶ Fully supports Shuttle workforce and facility transition efforts.
- ▶ Next launch is planned for this Sunday, February 7th.



21st Century Launch Complex

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---------------------------------|-------|-------|-------|-------|-------|
| Kennedy Space Center Facilities | \$429 | \$500 | \$400 | \$400 | \$200 |

- ▶ Makes a significant investment to modernize the Kennedy Space Center to increase the operational efficiency and reduce the launch costs not only for NASA, but for other users.
- ▶ Potential projects include:
 - ▶ Improvements to the effectiveness of the complex's range;
 - ▶ Changes to KSC's perimeter to allow increased access to KSC facilities;
 - ▶ Enhanced environmental cleanup; and
 - ▶ Improvements to payload processing capacity.

Space Technology

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|------------------|-------|---------|---------|---------|---------|
| Space technology | \$572 | \$1,012 | \$1,060 | \$1,064 | \$1,218 |

- ▶ Funds advancements in next-generation technologies, to help improve the Nation's leadership in key research areas, enable far-term capabilities, and spawn game-changing innovations to make NASA, other government and commercial space activities more capable and affordable.
- ▶ Involves a broad array of participants including academic, commercial and international partnerships and incorporates the current Innovative Partnerships Program (including the Small Business Innovative Research and Small Business Technology Transfer Research programs.)



- ▶ Focuses on key areas, such as communications, sensors, robotics, materials, and propulsion.
- ▶ Uses prizes and other innovative research funding mechanisms, in addition to grants and other more traditional funding mechanisms.

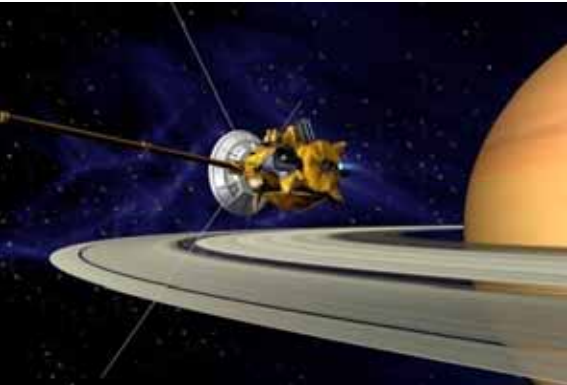
Earth and Climate Science

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|---------------|---------|---------|---------|---------|---------|
| Earth Science | \$1,802 | \$1,945 | \$2,090 | \$2,217 | \$2,282 |

- ▶ Increases by \$382 million over FY 2010 enacted, and \$1.8 billion over 4-years (FY 2011-14) compared to the FY 2010 Budget;
- ▶ Re-flies the Orbiting Carbon Observatory, which is critical to our understanding of the Earth's carbon cycle and its effect on climate change;
- ▶ Accelerates the development of new satellites to enhance observations of the climate and other Earth systems;
- ▶ Expands and accelerates Venture-class competitive PI-led missions;
- ▶ Enhances climate change modeling capabilities to enhance forecasts of regional and other effects;
- ▶ Operates 15 Earth-observing spacecraft in orbit and launches Glory, NPP, and Aquarius; and
- ▶ Proceeds toward completion and launch of remaining foundational missions: LDCM (6/13) and GPM (7/13).

Planetary Science

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------------|---------|---------|---------|---------|---------|
| Planetary Science | \$1,486 | \$1,547 | \$1,591 | \$1,630 | \$1,650 |

- ▶ Increases by \$16M/yr for identification and cataloging of Near Earth Objects;
 - ▶ Restarts Plutonium-238 production w/ DOE to support future missions;
 - ▶ Continues to operate 11 planetary missions and launches Juno and Gravity Recovery and Interior Laboratory (GRAIL);
 - ▶ Completes launch preparations for Mars Science Laboratory launch in fall of 2011;
- 
- ▶ Continues work toward LADEE and MAVEN launch in 2013;
 - ▶ Moves Mars 2016 mission into formulation;
 - ▶ Continues funding Europa Jupiter System Mission (EJSM) concept development; and
 - ▶ Begins flight development of the Advanced Stirling Radioisotope Generator (ASRG) for 2014/15 Launch Readiness Date.

Astrophysics

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------|---------|---------|---------|---------|---------|
| Astrophysics | \$1,076 | \$1,109 | \$1,149 | \$1,159 | \$1,132 |

- ▶ Continues to operate 15 missions;
 - ▶ Works toward NuSTAR launch in 2012 and Astro-H in 2014; and
 - ▶ Funds JWST at a 70% confidence level for launch in 2014.
- ▶ *Note: The new decadal survey is expected to establish science priorities for future missions.*



Heliophysics

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------|-------|-------|-------|-------|-------|
| Heliophysics | \$642 | \$648 | \$680 | \$704 | \$751 |

- ▶ Operates 17 missions with the launch of SDO in February;
- ▶ Works toward RBSP launch in 2012 and MMS launch in 2015;
- ▶ Initiates the highest priority “large” mission, Solar Probe Plus; and
- ▶ Funds Solar Orbiter Collaboration with ESA in project formulation. (NASA is providing key instruments and launch vehicle for ESA spacecraft).



Aeronautics and Green Aviation

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|-------------|-------|-------|-------|-------|-------|
| Aeronautics | \$580 | \$585 | \$590 | \$595 | \$600 |

- ▶ Increases by \$73 million over FY 2010 enacted, and \$0.3 billion over 4-years (FY 2011-14) compared to the FY 2010 Budget.
- ▶ In addition to the base program, includes:



- ✓ \$20 million per year for an aeronautics grant program to support NASA's environmentally responsible aviation program.
- ✓ \$20 million per year for research that will enhance NASA's ability to verify and validate complex software-based systems, with a focus on promoting reliable, secure, and safe use in the national airspace.
- ✓ \$30 million per year to address operational and safety issues related to the integration of unmanned aircraft systems (UAS) into the national airspace.

Cross-Agency Support and Construction

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------------|---------|---------|---------|---------|---------|
| Cross-Agency | \$3,111 | \$3,190 | \$3,279 | \$3,367 | \$3,462 |
| Construction & ECR | \$397 | \$364 | \$367 | \$394 | \$399 |

- ▶ Cross-Agency Support Highlights:
 - ▶ Continues to fund operations and maintenance of NASA's 9 field centers
 - ▶ Funds agency-wide management functions
 - ▶ Works to find efficiencies and drive down operating costs
- ▶ Construction and Environmental Compliance and Restoration Highlights:
 - ▶ Funds major repairs of NASA's facilities
 - ▶ Constructs new or modified facilities as required to conduct NASA's program missions
 - ▶ Manages NASA's environmental clean-up responsibilities

Education

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|-----------|-------|-------|-------|-------|-------|
| Education | \$146 | \$146 | \$146 | \$146 | \$147 |

- ▶ Increases the base NASA education program by \$20M to fund several new initiatives, including the recently announced *Summer of Innovation*.
- ▶ The *Summer of Innovation* will pilot programs over three years involving NASA scientists and curricula to inspire middle-school students and their teachers with exciting experiences that spur those students to continue in STEM careers.
- ▶ Other important programs include:
 - The Innovation in Higher Education STEM Education program and Innovations in Global Change Education program , which will focus on innovative ways to reach undergraduate and graduate students, improve student retention in STEM disciplines, leverage the research platform of the ISS, and better engage community colleges and minority institutions.
 - The NASA Informal Education Opportunities program, which will seek innovative approaches to conducting informal education in the Nation's science centers, museums, community groups, and other organizations.



Cancellation of Constellation Program

| | 2011 | 2012 | 2013 | 2014 | 2015 |
|--------------|---------|-------|------|------|------|
| Cx Close Out | \$1,900 | \$600 | -- | -- | -- |

- ▶ The FY 2011 Budget cancels the Constellation program and provides \$2.5 billion over two years for related facility and close-out costs including any increased cost for Shuttle transition due to Constellation cancellation.
- ▶ Working with the Congress, NASA will strive to close out the existing Constellation contracts as soon as possible.
- ▶ NASA will create a tiger team to assess workforce, procurement and other issues, which will report to the Administrator over the coming months.
- ▶ Most important, we are not ending our ambitions to explore space. In order to explore new frontiers, we are launching a vigorous new technology development and test program that will pursue game-changing technology development that can take us further and faster and more affordably into space.

An Exciting New Direction for NASA

- ▶ NASA's new strategic approach will spawn exciting developments in research and technology that will make future spaceflight more affordable and sustainable, inspire a new generation of Americans, and increase our knowledge of the solar system and the universe of which we are a part.
- ▶ This investment will ensure that future space explorers will have tools, capabilities and knowledge that we can only dream about today.
- ▶ NASA looks forward to working with the Congress and others to further the President's and the nation's goals for NASA.